near that date the mercury registered 20° below, but at noon it was 30° above, or a rise of 50° in five hours.

1875. November 30, the mercury remained below zero all day, the only such record occurring during forty-five years, and, according to Reuben Pierce's "Annals of the Weather," it was the only such record for November for eighty years past.

1880. June 25, the mercury registered 100°.

During the year 1894, three conditions of the weather were recorded, unparalled during the forty-five years.

a. March was very mild and open, scarcely any freezing weather during the first three weeks.

b. The drought of mid-summer was the most severe on record.

c. There was a week of good sleighing during the first half of November.

My record of snowfall shows that the average per winter on the hills in this neighborhood was nearly 8 feet. The winter of 1856–57 gave nearly 12 feet, while the winter of 1899–1900 gave 42 inches. The latter is the smallest on my record, the next larger was 4 feet 2 inches in 1857–58. The winter of 1898–99 gave 141 days of continuous sleighing. The winter of 1899–1900 gave the largest number of days of icy and slippery traveling. The snow blizzard of March 12–14, 1888, the dark day of September 6, 1881, and the extensive disastrous flood of October 4, 1869, are all indelibly impressed upon the mind. During the winter of 1868–69, the lowest extremes of temperature occurred in December and in March.

August is generally a hot, dry month, but in August, 1856, two freshets occurred, caused by heavy rainfalls.

I have seen frosts every month in the year, and killing frosts every month except July.

In the face of these climatic changes we are told that the West and South present much more severe and sudden changes than the climate of New England.

INTERNATIONAL SEISMOLOGICAL ASSOCIATION.

Up to the present time the MONTHLY WEATHER REVIEW has published items bearing on earthquakes, partly because of the general interest in this subject and because of the good records kept by meteorological observers, partly also because we have no journal especially devoted to this subject. At the recent International Conference at Strassburg, Prof. H. F. Reid, of Johns Hopkins University, was present as the official delegate from the United States, and more especially from the United States Geological Survey. He reports that the conference decided upon a form of organization for an international seismological association. The principal features of this association will be the formation of a central bureau for the collection, study, and publication of the reports sent from various countries, and the establishment of local bureaus and local seismological observatories in all parts of the world. A general assembly of delegates will meet at least once in four years. The expenses of the association will be met by contributions from each cooperating nation. A general report as to the instruments best adapted for recording earthquakes will be prepared, but meanwhile each observatory will select its own. It was unanimously decided that in describing earthquakes, and especially in the published official reports of the association, Greenwich mean civil time should be used. Those who are interested in this subject should correspond directly, either with Prof. Harry Fielding Reid of the Johns Hopkins University, Baltimore, Md., or with Professor Dr. Gerland, Director of the Central Seismological Station, Strassburg, Germany.

METEOROLOGY IN HAWAII.

The Governor of the Territory of Hawaii, Hon. G. R. Carter, under date of December 12, 1903, announces that—

The revenues of the territory have been reduced more than one-half, and it will be practically impossible to continue the maintenance of the meteorological service. Much as we should like to prevent a break in the records, yet absolute necessity will force us to discontinue the service. Economy must be practised in every department, and we can not continue the salary even of Mr. Lydecker as territorial meteorologist.

In reply to this communication, the Secretary of Agriculture has written as follows:

In answer to your letter of December 12, 1903, I have the honor to say that my estimates for the support of the Weather Service for the fiscal year beginning July 1, next, provide a sufficient sum to enable us to establish in the Hawaiian Islands a section of the Climate and Crop Service of the Weather Bureau. I am of the opinion that favorable action on these estimates will be taken by Congress. If so, immediately after the first of July next, an official from the Weather Bureau, with an assistant, will be sent to open an observatory at Honolulu. I shall then be glad to have such apparatus as you possess turned over to our representative, which I understand from your communication it is your desire to do. I am of the opinion that a weekly report of the condition of crops should be made and published, the same as is done for each one of our States, and that a monthly publication should be made on the climate of the islands. All this will be undertaken as soon as the means are put at our command.

Notwithstanding the foregoing it is hoped that the Hawaiian government may be able to keep up the meteorological records until the United States Government can relieve it of the work, probably next July. The surveyor general of Hawaii, Mr. E. Wall, is compiling a series of large maps of the archipelago, showing especially the location and elevations of the meteorological stations and other points of scientific interest.

INFLUENCE OF CONTINENTS AND OCEANS ON THE ATMOSPHERE.

In connection with his article in the MONTHLY WEATHER REVIEW, December, 1901, on the physical basis of long-range forecasting, the Editor has been asked how one can express in mathematical language, either analytical or graphic, the character of the different influences exerted on the atmosphere by the land and water, especially the land and water hemispheres there spoken of. Now it is evident that the action of the land differs from that of the ocean in three general respects: thermal, hygrometric, and mechanical, and the following points are to be considered:

1. The atmosphere above the land has a temperature by day higher than that above the water, and the laws expressing this are given in Professor Ferrel's Professional Paper of the Signal Service, No. 13, "Temperature of the Atmosphere and the Earth's Surface."

2. The atmosphere receives far more moisture from the ocean than from the land and the forests on the land, and even more than it does from the snow and ice that cover a portion of the land.

3. This superior content of moisture implies also higher specific heat and a vastly higher content of latent heat, all of which affects its subsequent behavior and phenomena.

4. The movement of the atmosphere over the land with its very irregular surface, is retarded far more than is its movement over the ocean. Even if the land be a smooth plain, a special form of increased resistence is introduced by the fact that during the daytime the heated air rises with a sluggish horizontal movement, and is replaced by descending air having more rapid horizontal movement. This sluggish air is, therefore, an obstacle to the rapidly moving air, not only near the ground, but also at the upper heights to which it rises. There is, therefore, a diurnal periodicity in the horizontal movement of the atmosphere; the latter is at low levels greatest in the middle of the day, but at high levels greatest in the night time. In the process of pushing sluggish air forward the rapidly moving currents convert a part of their kinetic energy into static pressure, and this gives rise to some of the terms in the so-called diurnal oscillation of the barometer. In general, as the air is slightly viscous, we represent the force required for an upper layer to slide over a lower layer by the term for viscosity introduced into the ordinary hydrodynamic equations, whose coefficient is μ (see p. 558, MONTHLY WEATHER REVIEW, December, 1901). Strictly speaking, viscosity is of slight importance, but if we consider the coefficient μ to be itself the summation of several terms, representing, respectively, (*a*) viscosity; (*b*) retardation due to vertical movements caused by orography, producing a mixture of swift upper with slower lower currents; (*c*) retardation due to vertical movements caused by local differences of temperature, producing the same mixture as in *b*; (*d*) retardation due to local differences of moisture; (*e*) that due to local falling rain (since that also is a mass that

has to be moved horizontally); then the sum total, which I call "convection-resistance" due to mixtures, presents an important factor in the turbulent motion of the atmosphere, and may be treated by methods that Boussinesq developed for the study of tumultuous river currents.

5. The reaction between the wind and the ocean by virtue of which surface waters are blown horizontally with a speed of perhaps 1 per cent of the general motion of the adjacent air, introduces a secondary term for the oceanic surface, which does not occur in the land surface, but this is comparatively a minor matter.

6. The superior quantity of latent heat contained in moist air is probably next in importance to the resistance offered by the irregularities of continental or other large masses of land, and its importance may be best evaluated by a study of the quantity of rain, snow, cloud, or fog. The formation of cloud or fog not only evolves latent heat, but entirely alters the coefficient of radiation or absorption of the atmosphere; cloudy air differs in these respects from clear air; the precipitation of rain or snow does even more than this, for it leaves a corresponding amount of latent heat free in the atmosphere, thereby permanently affecting its temperature, and the atmospheric temperature that our equations now have to deal with is that due on the one hand to insolation and its attendant absorption, conduction, and convection, and on the other hand to the latent heat left in the atmosphere by precipitation. The formation of cloud or fog as such, by virtue of the cooling due to expansion, does not materially affect the quantity of heat in the atmosphere. It produces only a temporary local phenomenon, since the expanding air is very soon brought under high pressure, compressed and warmed, before the latent heat, at first evolved, has had time to be lost by radiation or otherwise.

ORIGIN OF THE RARE GASES IN THE EARTH'S ATMOSPHERE.

In a report made by Dr. S. A. Mitchell on the spectroscopic work done by him during the solar eclipse of May 18, 1901, at Sumatra, and published by Columbia University (New York City), there occur the following interesting paragraphs relative to the earth's atmosphere and the spectra of the aurora borealis:

Consequently, it seems that the more volatile gases of terrestrial atmospheric air uncondensed at the temperature of liquid hydrogen, together with hydrogen, helium, neon, and argon, are present in the solar chromosphere, while the evidence in regard to krypton and xenon is inconclusive.

The finding of these gases in the sun and the undoubted presence of free hydrogen in the earth's atmosphere have an importance for cosmical physics that can hardly be overestimated. According to Liveing and Dewar, "if the earth can not retain hydrogen or originate it, then there must be a continued accession of hydrogen to the atmosphere (from interstellar space), and we can hardly resist the conclusion that a similar transfer of other gases must also take place." (Proc. Roy. Soc., vol. 67, p. 468, 1900.) It has been shown by these distinguished physicists, and again by Dewar in his presidential address before the British Association for the Advancement of Science, that these new gases, and particularly the more volatile gases of atmospheric air, play an important part in the spectra of the aurora, of nebulæ, and of the corona. "Of more than a hundred auroral rays observed by Stassano, more than two-thirds of them appear to belong to the more volatile gases of atmospheric air, while the majority of the remainder seem to belong to argon, krypton, and zenon." We are also told by Dewar that of a "list of 339 lines photographed by Humphreys during totality" [this, however, was called the spectrum of the corona, whereas it was the spectrum of the chromosphere] "only 55 do not differ by more than one unit on Ångström's scale from lines measured in the most volatile gases of the atmosphere or in krypton or xenon. It seems rather to the present writer that the great majority of these lines more closely correspond to Fraunhofer lines than to the lines of these rare gases.

These gases may take their origin from the earth itself; in fact, helium and neon are occluded from the waters of the Bath Spring in England. The presence of free hydrogen in the atmosphere can not be explained in this way. It is more likely that hydrogen comes to us in small ionized particles from the sun, being sent hither, as has been shown by Arrhenius, by the pressure of light; and likewise helium and the more volatile gases are present in the atmosphere through being repulsed from the sun by the ionization of small particles of these gases.

It seems, therefore, that the finding of these new gases in the sun's chromosphere is an independent verification of the truth of the theory of Arrhenius, which tells us that particles of matter are being continually scattered throughout the universe, starting from one sun and reaching another, with the result that all bodies of the universe are gradually becoming more and more alike.

THE WEATHER OF THE MONTH.

By Mr. W. B. STOCKMAN, District Forecaster, in charge of Division of Meteorological Records.

PRESSURE.

The distribution of mean atmospheric pressure is graphically shown on Chart IV and the average values and departures from normal are shown in Tables I and VI.

The mean monthly pressure was high from Kentucky, Tennessee, and Georgia northwestward to the coast of the northern and central Pacific districts, and the northern portions of the southern Pacific, with the crest overlying the northern Plateau, and a second area of relatively high but considerably lower mean pressure over the interior of Louisiana, Mississippi, and Alabama. At Boise, Idaho, the mean monthly pressure was 30.40 inches.

The mean pressure was lowest over the northern upper and eastern lower Lakes, northern Middle Atlantic States, and New England, which was the only portion of the country where the mean pressure was below 30.00 inches. The lowest mean monthly barometer reading was 29.90 inches at Eastport, Me.

The mean pressure was below the normal from Minnesota, Iowa, northern Missouri, eastern Kentucky, eastern Tennessee, and northeastern Georgia eastward to the Atlantic Ocean; and above the normal in all other districts.

The greatest minus departures ranged from —.05 to —.10 inch, and occurred in New England, the northern part of the Middle Atlantic States, the lower Lake region, and the northeastern half of the upper Lake region.

Throughout the entire Plateau region the barometer was .10 inch or more above the normal, maximum plus departures occurring over the middle Plateau, and the eastern portion of the north Pacific district, where they ranged from +.20 to +.23 inch.

The mean pressure decreased from that of November 1903, in the Lake regions, New England, Middle Atlantic States, northern portion of the South Atlantic States, eastern parts of the Ohio Valley and Tennessee, upper Mississippi Valley, Missouri Valley, North Dakota, and eastern Montana; and increased over the preceding month in the remaining portions of the United States. The greatest decreases occurred in the northern border States from Minnesota eastward, and were comparatively small, being less than .10 inch, while over the north Pacific, Plateau, and portions of the slope and middle Pacific regions the increase amounted to +.10 to +.28 inch, —the maximum occurring over the northern portions of the northern Plateau and north Pacific districts.

TEMPERATURE OF THE AIR.

The distribution of maximum, minimum, and average surface temperatures is graphically shown by the lines on Chart VI.

The mean temperature was below the normal from the west Gulf States, Missouri Valley, and central North Dakota eastward to the Atlantic Ocean, and in portions of the Plateau regions; and above the normal elsewhere. Over the region east of the Mississippi River the departures were very marked, and averaged from —4.0° to —10.1° per day, the maximum defi-